PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in Cooling Means of Hydraulic Torque Converters

We, AKTIEBOLAGET LJUNGSTRÖMS ÅNGTURBIN, a Corporation organized under the laws of the Kingdom of Sweden, of Nacka, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to the cooling of hydro-dynamic torque converters of the Fottinger or Lysholm type in which pump and turbine members operate in a working chamber providing for the circulation of hydraulic fluid in a closed path of flow.

Converters of the character under consideration operate at variable efficiencies, all materially less than 100% efficiency, and the power represented by the difference between the input power and the output power is transformed into heat which must be dissipated to prevent overheating of the converter.

Previously, hydraulic transmissions have been provided with jackets for a cooling liquid, such as water, and also with baffles inside the jacket space for ensuring efficient circulation, the cooling liquid in some cases being cooled in a radiator. In all these constructions the cooling system is individual to the hydraulic transmission.

Heretofore, the most common method of cooling hydro-dynamic torque converters to dissipate the heat generated, has been to withdraw a part of the working liquid from the working circuit, to pass it through a separate cooler and return the cooled liquid to the circuit. This arrangement involves certain difficulties and disadvantages, among which may be mentioned disturbance to the flow of the working liquid in the working chamber due to the withdrawal and re-introduction of part of the fluid and difficulty in keeping tight and free from leaks the outside separate cooler and the necessary conduits which usually include flexible hose or the like for connecting the cooler with the converter. In connection with this latter difficulty it has to be borne in mind that the hydraulic fluid which is ordinarily some kind of oil such as kerosene, Diesel oil, or even lubricating oil or various mixtures thereof, is under pressure which may vary from approximately 45 lbs. per sq. inch to as much as 90 lbs. per sq. inch or even more, when the converter is in operation and also usually has an operating temperature which may and frequently does exceed 212° F. sometimes reaching temperatures of the order of 300° F.

Cooling arrangements employing separate coolers for the converter have the further disadvantage of expensive construction and furthermore since the circulation of the liquid is usually effected by taking out liquid from the high pressure zone in the converter for cooling and returning the liquid to a low pressure zone, the circulation of the liquid and cooling of the converter is dependent on the converter being in operation to create the necessary pressure differential.

It has further previously been suggested, when converters have been driven by internal-combustion engines having liquid cooling systems, to utilize the same liquid for a working liquid in the converter and for cooling the engine, with the engine cooling system and the working circuit of the converter interconnected. The difficulty with the latter proposal is that it has been found impractical for numerous reasons to employ the same fluid both for hydraulic working fluid and as engine cooling fluid.

The primary object of this invention is to provide improved means for cooling converters of the kind under consideration, when they are driven by combustion engines having liquid cooling systems.

The present invention comprises the combination, with a combustion engine having a liquid cooling system including an engine cooling jacket, a pump for circulating cooling liquid and a cooler for said liquid, of an hydro-dynamic torque converter of the

type above mentioned driven by the engine, said converter having a jacketed housing providing a space for cooling liquid around the working chamber of the converter, and connections for conducting cooling liquid from the engine cooling system to and from said converter cooling jacket.

The invention will be hereinafter more fully described, with reference to the embodiments thereof illustrated by way of example in the accompanying drawings, in which :—

Figure 1 is a diagrammatic elevation illustrative of one embodiment of the invention ;

Figure 2 is a view similar to Figure 1 showing another embodiment ;

Figure 3 is a side elevation partly in section showing one form of converter housing construction embodying the invention ;

Figure 4 is a fragmentary plan view of the construction of Figure 3 with the outer casing broken away, illustrative of the path of flow of the cooling fluid with respect to the converter casing ;

Figure 5 is a view similar to Figure 3 of another form of converter casing structure ; and

Figure 6 is a view similar to Figure 4 showing the path of flow of the cooling liquid relative to the casing of Figure 5.

Referring more particularly to Figure 1, 10 denotes an internal-combustion engine to which is secured and from which is driven an hydro-dynamic torque converter of the Fottinger or Lysholm type, indicated generally at 12, and having a rotationally stationary casing 14 enclosing the working chamber of the converter. So far as the present invention is concerned, the construction of the converter may be of well-known kind. The casing 14 is jacketed for cooling liquid in a manner to be hereinafter described more in detail. The engine shown is of the liquid-cooled type provided with the usual engine cooler or radiator 16 from which the cooling liquid, usually water, is withdrawn through the connection 18 by the circulating pump 20 the outlet of which delivers the cooling liquid to the jacket spaces of the engine in the usual manner.

The outlet for the cooling liquid from the engine is indicated at 22 and may, in accordance with usual practice, contain a thermostat for restricting circulation through the engine block until the engine reaches normal operating temperature. The outlet 22 is connected with the inlet port 26 of the jacketed converter casing 54 by means of a conduit 28 and cooling liquid leaving the jacketed casing through the outlet port 30 is conducted through conduit 32 to the top inlet connection 34 of the radiator 16. As will be evident from the drawings the engine jacket space and the converter jacket space are in this arrangement connected in series, with the direction of flow of the cooling liquid being indicated by the several arrows 36.

In the embodiment shown in Figure 2, the general arrangement of the major components is the same as in the embodiment of Figure 1 and the description need not therefore be repeated. In this embodiment, however, the jacket spaces of the engine and of the converter instead of being connected in series are connected in parallel, the pump 20 not only delivering to the jacket spaces of the engine, but also being connected by means of conduit 38 with the inlet port 26 of the jacketed converter housing 14. The flow of cooling liquid from the outlet 30 of the latter is carried by conduit 42 to the radiator inlet 34 which also receives the discharge from the outlet 22 of the engine jacket space through the branch connection 44. The direction of flow of the cooling liquid is indicated by the several arrows 46. Advantageously, a thermostatically-controlled valve 48 responsive to the converter temperature is placed on the discharge side of the outlet port 30 of the converter cooling jacket.

Referring now to Figures 3 and 4 there is illustrated more in detail a suitable form of jacket arrangement for the converter housing. In this arrangement a portion of the converter housing surrounding the working chamber of the converter is formed with axially spaced circumferential grooves 50 and 52 containing packing rings of rubber or the like and an outer shell or jacket 54, which advantageously may be of sheet metal, is secured to the housing (by crimping or equivalent operations for effecting a fluid tight seal). The jacket 54 is provided with the inlet and outlet ports 26 and 30 and two series of axially extending baffles 56 and 58 are arranged within the jacket space to cause zig-zag flow of the cooling liquid around the periphery of the housing from the inlet port to the outlet port, as indicated by the arrows 60. The liquid is forced to flow around the casing by an axially extending partition or wall 62 located between the inlet 26 and the outlet 30.

Another form of jacket structure for the converter casing is shown in Figures 5 and 6. In this embodiment the jacket or shell 54 carries axially spaced circumferentially extending baffles 64 and 66 and an axially extending partition 68 for causing the cooling liquid to flow from the inlet 26 to the outlet 30 along the peripherally zig-zag path indicated by the arrows 70 axially of the jacket 54.

Obviously many other specific cooling jacket arrangements may be made for causing desired flow of the cooling liquid through the jacket space of the converter.

As previously mentioned, the usual hydraulic working liquid is some form of oil or fluid which at normal temperatures is more viscous than water and in order to reduce the losses occasioned by high viscosity of the working liquid, it is generally desirable to operate the converter at relatively high temperature in order to reduce the viscosity of the working liquid, the normal desirable operating temperature of the working liquid usually being higher than the normally desired operating temperature of the engine cooling liquid which in nearly all instances is water. The present invention enables the desired relative temperatures to be employed, while at the same time obtaining a relatively high rate of heat flow through the converter casing. On the one hand there is within the converter a body of working liquid operating at high temperature and high velocity so that a high rate of heat transfer from the liquid to the casing is obtained even though the heat transfer co-efficient from the oily liquid is relatively very low. On the other hand the cooling liquid flowing through the converter jacket is usually water which has a relatively very high co-efficient of heat transfer and has moreover a considerably larger area of heat transfer surface to contact than does the working liquid. Consequently, the amount of heat absorption by the cooling water necessary to cool the converter effectively can be obtained with relatively low velocity flow of the cooling water through the jacket, so that effective cooling can be obtained without material pressure drop and consequent absorption of power for circulating the cooling liquid through the converter jacket.

The series flow arrangement shown in Figure 1 is ordinarily preferable where the operating conditions are such that the converter is under more or less constant and substantial load. In this arrangement the converter receives cooling water which is preheated by first passing through the engine jackets so that the cooling of the converter is carried out at a relatively high level of cooling water temperature. With constant load operation, even though the load be relatively heavy, the amount of heat required to be absorbed from the converter is still sufficiently small so that it can be satisfactorily absorbed in a series system of the kind shown in Figure 1.

In cases where the load may fluctuate and may frequently result in extreme peak loads on the converter of short duration, the parallel flow system shown in Figure 2 is generally to be preferred. In this system the converter jacket is supplied with relatively low temperature cooling water taken from the outlet of the radiator so that a greater cooling effect for the converter can be obtained if needed than with the series arrangement shown in Figure 1. In order to prevent over-cooling under light load conditions, the thermostatically-controlled valve 48 is advantageously employed to restrict the flow of relatively cool water through the converter jacket under light load conditions. Obviously in the system shown in Figure 2 where there are two fluid cooling passages in parallel, the resistances to flow through the parallel circuits must be related to each other so as to ensure a sufficient hydraulic head on each circuit to ensure circulation. This, of course, may readily be effected by many different design variations including, for example, the proper choice of size of the piping or hose connections required to adjust the relative resistance to flow of liquid through the two parallel circuits.

So far as the jacketing arrangements shown in Figures 3 and 5 are concerned, each may be used with either of the flow systems shown in Figures 1 and 2, and it will be evident that many changes in the design and arrangements of the parts may be made within the scope of the invention.

What we claim is :—

1. The combination, with a combustion engine having a liquid cooling system including an engine cooling jacket, a pump for circulating cooling liquid and a cooler for said liquid, of an hydro-dynamic torque converter of the Fottinger or Lysholm type driven by the engine, said converter having a jacketed housing providing a space for cooling liquid around the working chamber of the converter, and connections for conducting cooling liquid from the engine cooling system to and from said converter cooling jacket.

2. Apparatus according to Claim 1, in which the connections are arranged to provide for flow of cooling liquid in parallel through the engine and converter cooling jackets between the outlet of the circulating pump and the inlet of the cooler.

3. Apparatus according to Claim 2, in which a thermostatically-controlled valve responsive to converter temperature is located in the outlet connection from the converter for controlling flow of cooling liquid through the converter cooling jacket.

4. Apparatus according to Claim 1, in which the connections are arranged to provide for flow of cooling liquid in series through said cooling jackets.

5. Apparatus according to Claim 4, in which the series flow of cooling fluid from the cooler is through the engine cooling jacket and through the converter cooling jacket in the order named.

6. Apparatus according to any of the preceding claims, which includes guide means for causing the cooling liquid to follow a tortuous path of flow through the converter cooling jacket between the inlet and outlet thereof.

7. Apparatus according to Claim 6, in which the guide means comprises a plurality of axially-extending baffles and an axially-extending wall located between the inlet and the outlet of the jacket for causing the cooling liquid to follow an axially zig-zag path of flow around the converter.

8. Apparatus according to Claim 6, in which the guide means comprises a plurality of axially-spaced circumferentially-extending baffles and an axially-extending wall located between the inlet and the outlet of the jacket for causing the cooling liquid to follow a peripherally zig-zag path of flow axially of the jacket.

9. A cooling system for an hydro-dynamic torque converter driven by an engine having a cooling system, constructed, and arranged substantially as described, with reference to Figure 1 or to Figure 2 of the accompanying drawings.

10. A cooling system according to Claim 9 having a jacketed housing of an hydro-dynamic torque converter of the Fottinger or Lysholm type, constructed and arranged substantially as described, with reference to Figures 3 and 4 or to Figures 5 and 6 of the accompanying drawings.

FRANK WATSON,
Agent for the Applicants,
Aldwych House,
Aldwych, London, W.C.2.

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Fig. 1.

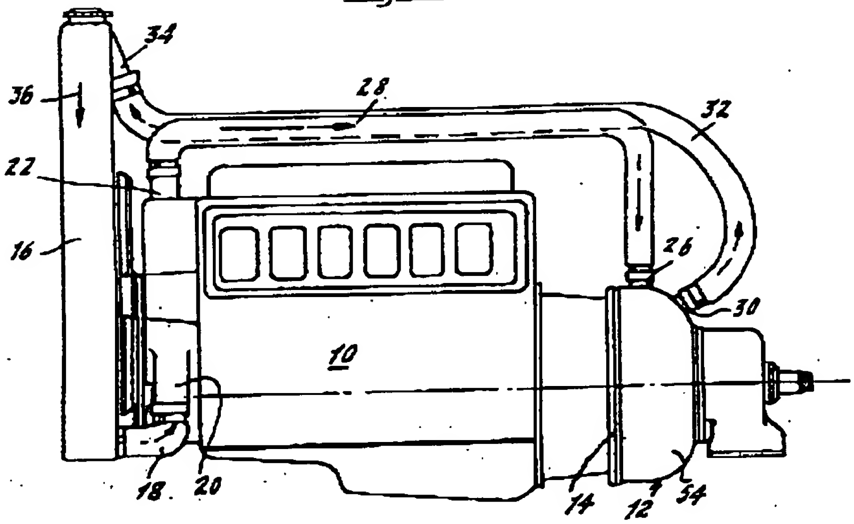
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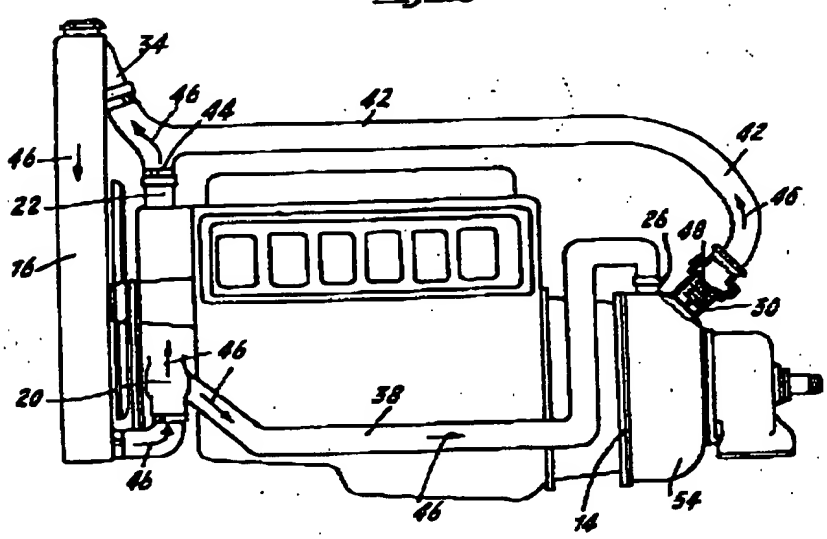
Fig. 2.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679,512 COMPLETE SPECIFICATION
2 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

Fig. 3.

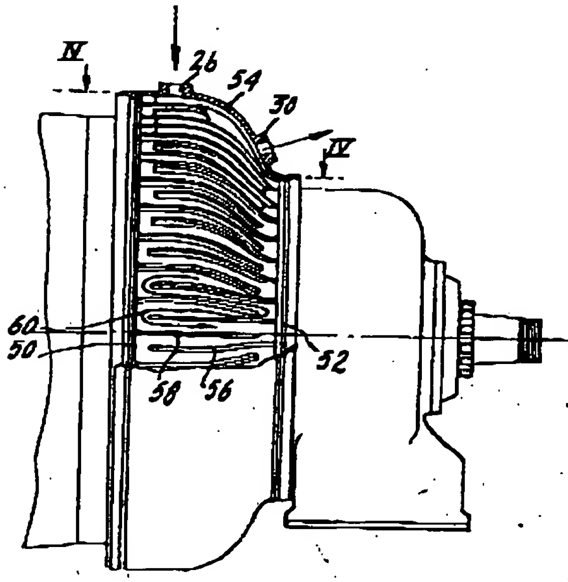

Fig. 4.

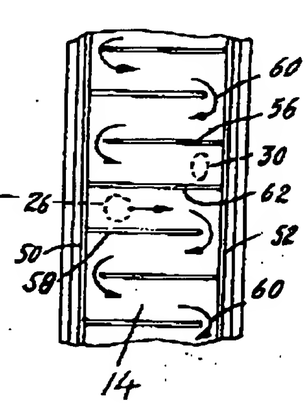

Fig. 5.

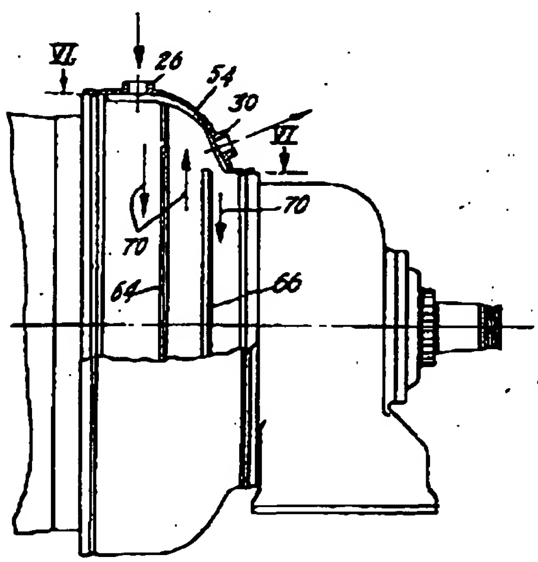

Fig. 6.